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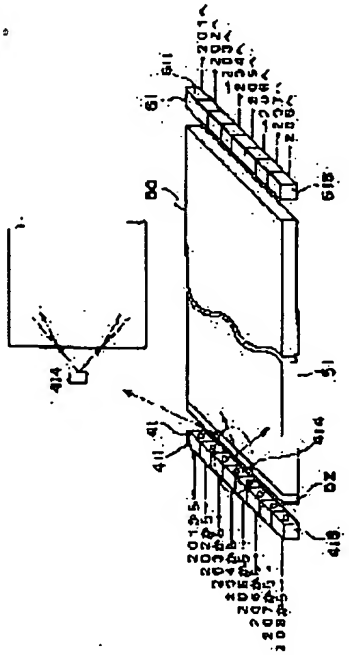
(54) OPTICAL BUS CIRCUIT BOARD

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an optical bus circuit board high in light availability and distributive uniformity.
SOLUTION: Electrical signals from an electronic circuit board 204 are converted into optical signals by an electric/optic conversion circuit 40, optical signals are generated from a laser diode 414, and generated optical signals are entered into the end surface of a translucent medium 51. The entered optical signals undergo repeated total reflections and are propagated within the translucent medium 51, are exited from the other end surface of the light translucent medium 51 and are received by photodiodes 611-618. Received optical signals are converted into electrical signals by an opto-electric conversion circuit 60 and are transmitted to respective electronic circuit boards 201-208.



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CLAIMS

[Claim(s)]
[Claim 1] While having the predetermined field where direct incidence of said lightwave signal is carried out to the electrical and electric equipment and the optical conversion circuit which changes into a lightwave signal the electrical signal inputted through two or more electrical connectors prepared corresponding to two or more electronic-circuitry substrates of each, and said two or more electrical connectors The lightwave signal transmission equipment equipped with said light guide means to transmit said lightwave signal so that it may go to a larger field than said predetermined field, and to transmit lightwave signals other than the lightwave signal which carries out direct incidence to this predetermined field among these lightwave signals to this predetermined field, The optical bus circuit substrate equipped with light and an electric conversion circuit which changes into an electrical signal the lightwave signal which carries out incidence to said predetermined field, and is outputted to these two or more electrical connectors.
[Claim 2] Said light guide means is an optical bus circuit substrate according to claim 1 characterized by transmitting lightwave signals other than the lightwave signal which carries out direct incidence to said predetermined field throughout said predetermined field.
[Claim 3] Said lightwave signal transmission equipment is an optical bus circuit substrate according to claim 1 or 2 characterized by being constituted by the die length which fills the relation of tan alpha>=tan 3alpha' when the maximum prospective angle from the incidence section of this lightwave signal of 2alpha and said light guide means to a predetermined field is made into 2alpha' for the angle of divergence of said lightwave signal.
[Claim 4] Said lightwave signal transport unit is an optical bus circuit substrate given in any 1 term of claim 1 characterized by what an optical diffusion means to diffuse the lightwave signal outputted from said electrical and electric equipment and optical conversion circuit is included for thru/or claim 3.
[Claim 5] Said lightwave signal transmission equipment is an optical bus circuit substrate according to claim 4 characterized by defining the diffusion angle so that the relation of tan theta>=tan 3theta' may be filled when the maximum prospective angle from 2theta and said optical diffusion means to a predetermined field is made into 2theta' for the diffusion angle of said optical diffusion means.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to an optical bus circuit substrate, and relates to the optical bus circuit substrate which inputs into these two or more electronic-circuitry substrates in more detail the electrical signal outputted by any of two or more electronic-circuitry substrates they are.
[0002]
[Description of the Prior Art] In recent years, the circuitry of the circuit board (daughter board) used with data processing system has been increasing substantially by development of a very large-scale integrated circuit (VLSI). Since the number of signal connection to each circuit board increases as circuitry increases, the juxtaposition architecture which needs many connection connectors and path cords is adopted as the data bus board (mother board) which connects between each circuit board (daughter board) by the bus structure. Although improvement in the working speed of a juxtaposition bus has been measured by advancing parallelization by multilayering and detailed-izing of a path cord, the processing speed of a system may be restricted with the working speed of a juxtaposition bus by the signal delay resulting from the capacity between connection wiring, or connection wiring resistance. moreover, the electromagnetism by the densification of juxtaposition bus connection wiring -- the problem of a noise (EMI:Electromagnetic Interference) also serves as big constraint to the improvement in processing speed of a system.
[0003] In order to solve such a problem and to measure improvement in the working speed of a juxtaposition bus, using the system intrinsic-light connection technique called an optical interconnection is examined. The outline of an optical interconnection technique is Uchida and a circuit mounting academic lecture convention. Various gestalten are proposed according to the content of the structure of a system as indicated by 15C01, p.201-202 and H.Tomimuro et al, IEEE Tokyo Section Denshi Tokyo, No.33, and p.81-86 (1994).
[0004] In the optical interconnection technique of various gestalten by which the conventional proposal was made, as an optical data transmission method between the circuit boards in which luminescence or a photo detector was carried, luminescence/light-receiving device is arranged to front flesh-side both sides of each circuit board, and the serial light data bus for the loop transmission between each circuit board which combined spatially between luminescence/light-receiving devices on the adjoining circuit board which was included in the system frame with light is proposed by JP,2-41042,A. Light and electric conversion are carried out by the circuit board which the lightwave signal sent from a certain circuit board of one sheet adjoins by this method, and the electrical and electric equipment and optical conversion are further carried out once again by that circuit board, and while each circuit board is arranged by the serial one by one and repeats photoelectricity conversion, and the electrical and electric equipment and optical conversion on each circuit board, it is transmitted among all the circuit boards included in the system frame, as a lightwave signal is sent to the circuit board which adjoins a degree. For this reason, a signal transduction rate receives that constraint at the same time it is dependent on light and electric conversion of light-receiving/luminescence device arranged on each circuit board, and the electrical and electric equipment and an optical conversion rate. Moreover, since the optical coupling by light-receiving/luminescence device arranged on each circuit board between which free space was made to be placed is used for the data transmission between each circuit board, interference (cross talk) of adjoining optical data-transmission-line Hazama occurs, and poor transmission of data is expected. Moreover, when lightwave signals are scattered about according to the environment in a system frame, for example, dust etc., it is also expected that poor transmission of data occurs.
[0005] In JP,61-196210,A, in order to combine optically between the circuit boards in which luminescence

or a photo detector was carried, the method which performs data transmission through the optical path constituted by the diffraction grating arranged on the transparent plate front face and the reflective component is indicated. By this method, since it is not connectable with one point which had the light emitted from one point fixed, between [no] circuit boards can be covered like an electric bus, and it cannot connect.

[0006] Moreover, the method which connects the conventional specialized circuit substrate (electronic substrate) to an optical bus circuit substrate through a connector is proposed. It is indicated that it is characterized by preparing on the substrate which unified the optical transmission network to which between two or more optical sending circuits which change the output electrical signal from a specialized circuit (electronic substrate) into a lightwave signal, two or more optical receiving circuits which change a lightwave signal into the input electrical signal to a specialized circuit, and two or more optical sending circuits and optical receiving circuits is connected with JP,8-166842,A. Constituting an optical transmission network from an optical star coupler, an optical fiber, an input/output terminal, and a light amplifier is indicated by JP,8-166842,A. The lightwave signal distribution circuit board which equipped JP,10-135911,A with the light and the electric conversion circuit which changes into an electrical signal the lightwave signal distributed in two or more circuit boards (electronic substrate) with the distributor which distributes the signal from the electrical and electric equipment and an optical conversion circuit, and the electrical and electric equipment and an optical conversion circuit through an electrical connector is proposed. In the lightwave signal distribution circuit board shown in JP,10-135911,A, it is characterized by connecting with the optical waveguide object embedded at the lightwave signal distribution circuit board in between the optical distributor, the electrical and electric equipment and an optical conversion circuit, or light and an electric conversion circuit, and an optical fiber core wire or organic optical waveguide is used as an optical star coupler and an optical waveguide object as an optical distributor.

[0007] Respectively, the optical star coupler of current, eight inputs marketed, and eight outputs has 142mmx24mmx13mm (LxWxH) extent and large size, and the branching homogeneity of superfluous loss and a branching ratio (the maximum insertion-loss-minimum insertion loss) is [loss by 3dB, about 2.5dB and the optical star coupler is also large, and] also bad. Moreover, since the optical fiber is used as an optical transmission line, the circuit boards, such as connection of an optical fiber and wiring of an optical fiber, may be enlarged. Moreover, in order to gather transmission speed in bus transmission, the parallel signal which consists of two or more bits is usually transmitted. Therefore, when performing parallel processing, two or more optical transmission circuit boards using the optical star coupler and optical fiber which were mentioned above are needed, and have the problem that equipment including the optical transmission circuit board is enlarged.

[0008]

[Problem(s) to be Solved by the Invention] This invention aims at offering the possible optical bus circuit substrate of raising the utilization effectiveness of light in view of the above-mentioned situation.

[0009]

[Means for Solving the Problem] Two or more electrical connectors in which invention according to claim 1 was prepared corresponding to two or more electronic-circuitry substrates of each for the above-mentioned object achievement, While having the predetermined field where direct incidence of said lightwave signal is carried out to the electrical and electric equipment and the optical conversion circuit which changes into a lightwave signal the electrical signal inputted through said two or more electrical connectors The lightwave signal transmission equipment equipped with said light guide means to transmit said lightwave signal so that it may go to a larger field than said predetermined field, and to transmit lightwave signals other than the lightwave signal which carries out direct incidence to this predetermined field among these lightwave signals to this predetermined field, The lightwave signal which carries out incidence to said predetermined field is changed into an electrical signal, and the optical bus circuit substrate equipped with light and an electric conversion circuit outputted to these two or more electrical connectors is offered.

[0010] When the electrical signal outputted from either of two or more electronic-circuitry substrates is inputted into an electrical connector, the electrical and electric equipment and an optical conversion circuit change into a lightwave signal the electrical signal inputted through an electrical connector. A lightwave signal transport unit transmits the lightwave signal outputted from the electrical and electric equipment and an optical conversion circuit to a larger field than the predetermined field of a light guide means. Lightwave signals other than the lightwave signal which carries out direct incidence to this predetermined field among the transmitted lightwave signals are transmitted to a predetermined field by the light guide means.

[0011] Therefore, it is transmitted to a predetermined field and incidence of the lightwave signal (the 2nd

lightwave signal) and ** which were transmitted by light guide means other than the lightwave signal which carries out direct incidence to this predetermined field is carried out to it among the lightwave signal (the 1st lightwave signal) which carries out direct incidence to this predetermined field, and this transmitted lightwave signal.

[0012] Light and an electric conversion circuit receive the lightwave signal (the 1st lightwave signal and 2nd lightwave signal) which carries out incidence to the predetermined field of a light guide means, and changes it into an electrical signal. The changed electrical signal is outputted to said two or more electrical connectors. Thereby, an electrical signal is inputted into each electronic-circuitry substrate.

[0013] Thus, the electrical signal outputted from either of two or more electronic-circuitry substrates is changed into a lightwave signal. Transmit lightwave signals other than the lightwave signal which transmits the changed lightwave signal and carries out direct incidence to the predetermined field of a light guide means among these transmitted lightwave signals to a predetermined field with a light guide means, and divide the lightwave signal which carries out incidence to a predetermined field, and light is received. It changes into an electrical signal and two or more changed electrical signals are outputted to two or more electrical connectors.

[0014] That is, since he is trying to transmit to the predetermined field of a light guide means, lightwave signals other than the lightwave signal which carries out direct incidence to a predetermined field among the transmitted lightwave signals can also raise the branching homogeneity of the lightwave signal in the case of changing and transmitting to a lightwave signal, once transforming again into an electrical signal the electrical signal outputted from either of two or more electronic-circuitry substrates, and inputting it into these two or more electronic-circuitry substrates.

[0015] It is characterized by transmitting lightwave signals other than the lightwave signal with which said light guide means carries out direct incidence of the invention according to claim 2 to said predetermined field in invention according to claim 1 throughout said predetermined field.

[0016] Invention according to claim 3 is characterized by said lightwave signal transmission equipment being constituted by the die length which fills the relation of tan alpha>=tan 3alpha' when the maximum prospective angle from the incidence section of this lightwave signal of 2alpha and said light guide means to a predetermined field is made into 2alpha' for the angle of divergence of said lightwave signal in invention according to claim 1 or 2.

[0017] According to claim 2 and invention according to claim 3, it is not concerned with the location of a light guide means by which incidence of the lightwave signal is carried out, and the location by which outgoing radiation is carried out, but it is transmitted to homogeneity to a predetermined field, and even if a lightwave signal receives the lightwave signal by which outgoing radiation is carried out from which location, it can obtain the same optical reinforcement.

[0018] Invention according to claim 4 is characterized by what said lightwave signal transport unit includes an optical diffusion means to diffuse the lightwave signal outputted from said electrical and electric equipment and optical conversion circuit for in invention given in any 1 term of claim 1 thru/or claim 3.

[0019] In invention according to claim 5, when said lightwave signal transmission equipment makes 2theta' the maximum prospective angle from 2theta and said optical diffusion means to a predetermined field for the diffusion angle of said optical diffusion means in invention according to claim 4, it is characterized by the thing to which the diffusion angle is set to fill the relation of tan theta>=tan 3theta' and which is constituted.

[0020] According to claim 4 and invention according to claim 5, a light guide means transmits lightwave signals other than the lightwave signal which carries out direct incidence (the 2nd lightwave signal) throughout a predetermined field to the predetermined field of a light guide means. Thus, since lightwave signals other than the lightwave signal which carries out direct incidence are transmitted to a predetermined field throughout a predetermined field, the amount of incident light to a predetermined field can be made into homogeneity. Moreover, since the lightwave signal by which incidence is carried out to a light guide means is diffused with the optical diffusion means, even if it shortens a light guide means compared with the case where a lightwave signal is not diffused, the amount of incident light to a predetermined field can be made into homogeneity, and the optical bus circuit substrate of this invention can be made small.

[0021] Moreover, a light guide means does not emit the 2nd lightwave signal outside, but you may make it transmit it to a predetermined field altogether. Thereby, the utilization effectiveness of a lightwave signal can be raised further.

[0022] In addition, a transparency mold is sufficient as an optical diffusion means, and a reflective mold is sufficient as it. Moreover, you may make it have the reflector which reflects a lightwave signal at least in

one side by the side of the incidence of the lightwave signal of a lightwave signal transport unit, and outgoing radiation in view of improvement in the utilization effectiveness of a lightwave signal.
[0023] Moreover, said electrical and electric equipment and optical inverter may be equipped with two or more light emitting devices arranged in the shape of an array, and may be equipped with two or more photo detectors arranged in the shape of an array. Thus, the miniaturization of an optical bus circuit substrate and simplification of mounting are realizable by arranging either [at least] the light emitting device of the electrical and electric equipment and an optical inverter, or the photo detector of light and an electric conversion means in the shape of an array.
[0024]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing.
[0025] [Gestalt of the 1st operation] as shown in drawing 1, to the optical bus circuit substrate 10 concerning the gestalt of this operation Two or more electrical connectors 30 (301-308) for connecting with two or more electronic-circuitry substrate 20 (201-208) each, The electrical signal from an electrical connector 30 (301-308) It has the light and the electric conversion circuit 60 which changes the electrical and electric equipment and the optical conversion circuit 40 changed into a lightwave signal, the lightwave signal transport unit 50 which transmits a lightwave signal, and the transmitted lightwave signal into an electrical signal, and is outputted to an electrical connector 30 (301-308). In addition, two or more electrical connector 30 and the electrical and electric equipment and an optical conversion circuit 40, light and an electric conversion circuit 60, and two or more electrical connectors 30 are connected by the electric wiring which is not illustrated.
[0026] Here, the electrical and electric equipment and the optical conversion circuit 40 are constituted by two or more laser diodes 41 (411-418) and laser diode actuation circuits 42 as shown also in drawing 2 . Moreover, light and the electric conversion circuit 60 consist of two or more photodiodes 61 (611-618), a photodiode actuation circuit 62, and an amplifying circuit 63 amplified to the level which can change the light-receiving signal in a photodiode as a logic signal. And the lightwave signal transport unit 50 consists of penetrated type light diffusion layers 52 as the translucency medium 51 as a light guide means of this invention of a rectangular parallelepiped configuration, and an optical diffusion means of this invention, as shown in drawing 2. In addition, with the gestalt of this operation, the penetrated type light diffusion layer 52 is arranged in the optical incidence side edge side of the translucency medium 51.
[0027] Next, an operation of the gestalt of this operation is explained.
[0028] The laser diode actuation circuit 42 controls the laser diodes 411-418 corresponding to the electronic-circuitry substrate 20 which inputted the electrical signal, and is made to emit light by inputting the electrical signal from each electronic-circuitry substrates 201-208 into the laser diode actuation circuit 42 through electrical connectors 301-308, namely, an electrical signal is changed into a lightwave signal, and incidence is carried out to the lightwave signal transport unit 50.
[0029] The lightwave signal which branched by the lightwave signal transport unit 50 is received with the photodiodes 611-618 in light and the electric conversion circuit 60, as shown also in drawing 15 . The photodiodes 611-618 which received the lightwave signal input an electrical signal into the photodiode actuation circuit 62, and the electrical signal from the photodiode actuation circuit 62 is amplified in an amplifying circuit 63, and is transmitted to the electronic-circuitry substrates 201-208 through electrical connectors 301-308.
[0030] In addition, the lightwave signal transport unit 50 functions as an optical bus which transmits the lightwave signal from one laser diode to two or more photodiodes by using diffusion of light. And the optical bus circuit substrate makes possible the bus connection between each electronic-circuitry substrate 201-208 as a whole.
[0031] Here, an operation of the lightwave signal transport unit 50, a laser diode 41, and a photodiode 61 is further explained to a detail. The electrical signal from each electronic-circuitry substrate 20 (for example, drawing 2 electronic-circuitry substrate 204) is changed into a lightwave signal by the electrical and electric equipment and the optical conversion circuit 40, from a laser diode 41 (for example, drawing 2 laser diode 414), a lightwave signal occurs and incidence of the generated lightwave signal is carried out to the end face of the translucency medium 51 by which the penetrated type light diffusion layer 52 has been arranged. This lightwave signal is diffused to a larger field than all the light-receiving fields of photodiodes 611-618 also in a longitudinal direction (direction parallel to the array of the cross direction of the translucency medium 51, i.e., two or more laser diodes, and two or more photodiodes) while diffusing it in the vertical direction (the thickness direction of the translucency medium 51), if the penetrated type light diffusion layer 52 is passed.

[0032] Although the diffused light has some which carry out direct incidence in all the light-receiving fields of photodiodes 611-618, there is also the diffused light which repeats total reflection propagation and carries out incidence of the inside of the translucency medium 51 to all the light-receiving fields of photodiodes 611-618. Outgoing radiation is carried out from the other-end side of the translucency medium 51, and light is received with a photodiode 61 (each photodiodes 611-618). The received lightwave signal is changed into an electrical signal by light and the electric conversion circuit 60, and is transmitted to each electronic-circuitry substrate 20 (each electronic-circuitry substrates 201, 202, 203, 204, 205, 206, 207, and 208).
[0033] Here, when the greatest prospective angle from an end face to the end face by the side of outgoing radiation by the side of the incidence of 2theta and said translucency medium 51 is made into 2theta' for the angle of divergence to the longitudinal direction of the diffused light diffused according to the penetrated type light diffusion layer 52, the lightwave signal transport unit 50 (the translucency medium 51 and penetrated type light diffusion layer 52) consists of gestalten of this operation so that the relation of tantheta>=3tantheta' may be filled.
[0034] Thereby, once [at least], the diffused light is diffused according to the penetrated type light diffusion layer 52 by carrying out total reflection on the side face of the translucency medium 51, and becomes possible [making into homogeneity outgoing radiation light reinforcement of the diffused light transmitted to a photodiode 61].
[0035] Namely, as mentioned above, so that the relation of tantheta>=3tantheta' may be filled If the lightwave signal transport unit 50 is constituted, as shown in drawing 9 (A) and drawing 9 (B) The inside of the diffused light (lightwave signal) diffused in the longitudinal direction according to the penetrated type light diffusion layer 52, The diffused lights (total reflection incident light (the 2nd lightwave signal)) other than the diffused light (direct incident light (the 1st lightwave signal)) directly transmitted to the outgoing radiation side edge side of the translucency medium 51 Once [at least], total reflection is carried out on the side face of the translucency medium 51, and even if there are few outgoing radiation side edge sides of the translucency medium 51, it is crossed and transmitted to the whole surface. On the other hand, every time it goes across light other than the diffused light by which it is directly transmitted to the outgoing radiation side edge side of the translucency medium 51 among the above-mentioned diffused lights in the configuration of tantheta<3tantheta' throughout the outgoing radiation side edge side of the translucency medium 51, they is not transmitted, but the homogeneity of the outgoing radiation light reinforcement of the outgoing radiation side edge side of the translucency medium 51 worsens. In addition, in the configuration of tantheta=3tantheta', as shown in drawing 9 (B), the diffused-light signal (total reflection incident light) which carried out total reflection on the side face of right and left of the translucency medium 51 carries out incidence all over the outgoing radiation side edge side of the translucency medium 51 exactly, and it becomes possible to raise the homogeneity of the outgoing radiation light reinforcement of this outgoing radiation side edge side of it.
[0036] Moreover, the thing fulfilled for the relation of theta<=phi when numerical aperture of 2theta and the translucency medium 51 is set to sinphi for the angle of divergence to the vertical direction or longitudinal direction of the diffused light diffused according to the penetrated type light diffusion layer 52, That is, the incident angle to the vertical side of the translucency medium 51 of the diffused light can be carried out beyond a critical angle, a lightwave signal is not emitted outside by this, but since total reflection of all the diffused lights is carried out in respect of the upper and lower sides of the translucency medium 51 and it can be used, it becomes possible to gather the utilization effectiveness of a lightwave signal.
[0037] According to the optical bus circuit substrate of the gestalt of this operation, as explained above, poor transmission of data can be prevented, the utilization effectiveness of light is high, branching homogeneity is good, the miniaturization of an optical transmission circuit is possible, and the signal transmission between the electronic-circuitry substrates of arbitration becomes possible. Moreover, in order to use a translucency ingredient as a transmission medium, unlike the case where space is transmitted to a lightwave signal, an optical bus system with the high resistance over environmental variations, such as a temperature change and dust, is obtained.
[0038] [Example] In the gestalt of the 1st operation here the translucency medium 51 The overall length of 40mm, It is 1mm in width of face of 8mm, and thickness, and penetrated type light dispersion equipment 52 is beam plastic surgery diffuser:LSD (product made from Physical Optics Corporation) 0.2x40PC-8 (the angle of divergence of the thickness direction of the translucency medium 51 of the diffused light 0.2 degrees). When a crosswise angle of divergence uses the lightwave signal transport unit 50 which is 40 degrees, the efficiency for light utilization of the lightwave signal transport unit 50 is total. At about 55% The value with the very as good homogeneity (the maximum effectiveness-minimum effectiveness) (/(the

maximum effectiveness + minimum effectiveness)) of outgoing radiation light reinforcement (x100[%]) as 3% is acquired. In addition, as the light source, the laser diode of a 680nm end-face luminescence mold was used.

[0039] In addition, as shown in drawing 3 , the lightwave signal transport unit 50 does not need to have the optical diffusion layer 52. In this case, it lengthens compared with the case where the lightwave signal transport unit 50 shown in drawing 2 in the die length (between a laser diode 41 and photodiodes 61) of the longitudinal direction of the translucency medium 51 has the optical diffusion layer 52. Thus, even when the lightwave signal transport unit 50 does not have the optical diffusion layer 52 and the angle of divergence of incident light does not have sufficient magnitude by lengthening distance of a light guide means, within the translucency medium 51, the lightwave signal by which incidence was carried out repeats reflective propagation, and is transmitted throughout an outgoing radiation side edge side.

[0040] The angle of divergence to the longitudinal direction of the lightwave signal by which incidence is carried out to a detail from a photodiode so that it may be shown by drawing 9 (C) 2alpha, By constituting the translucency medium 51 to the die length which fills the relation of tanalpha>=3tanalpha', when the greatest prospective angle from an end face to the end face by the side of outgoing radiation by the side of the incidence of the translucency medium 51 is made into 2alpha' Within the translucency medium 51, the lightwave signal by which incidence was carried out repeats reflective propagation, and is transmitted throughout an outgoing radiation side edge side.

[0041] That is, angle-of-divergence 2alpha to right and left of a lightwave signal becomes a small include angle relatively compared with diffusion angle 2theta of the lightwave signal shown in drawing 9 (A) and (B). For this reason, the direction in case the distance from the incidence section of a lightwave signal to the location of the side face in which a lightwave signal is reflected within the lightwave signal transport unit 50 does not have an optical diffusion layer becomes long relatively. Therefore, when the lightwave signal transport unit 50 does not have the optical diffusion layer 52, it is necessary to lengthen distance of a light guide means.

[0042] [Gestalt of the 2nd operation] Next, the gestalt of operation of the 2nd of this invention is explained. In addition, since the gestalt of this operation has the same component as the gestalt of the 1st operation mentioned above, the same sign is given to the same component, the explanation is omitted, and only a different part is explained.

[0043] Drawing 4 shows the outline block diagram of the lightwave signal transport unit 50 in the gestalt of the 2nd operation, a laser diode 41, and a photodiode 61. The lightwave signal transport unit 50 consists of reflected type light diffusion layers 53 as the translucency medium 51 of a rectangular parallelepiped configuration, and an optical diffusion means of this invention here. That is, more, the reflected type light diffusion layer 53 is arranged at one end face of the translucency medium 51, and the other-end side of the translucency medium 51 functions on a detail as the close outgoing radiation section (the one half of the array direction of a longitudinal direction, i.e., a laser diode, and a photodiode is the incidence section, and the remaining one half is the outgoing radiation section).

[0044] Next, an operation of the gestalt of this operation is explained. The electrical signal from each electronic-circuitry substrate 20 (for example, drawing 4 electronic-circuitry substrate 206) The lightwave signal which was changed into the lightwave signal by the electrical and electric equipment and the optical conversion circuit 40, and was emitted from the laser diode 41 (for example, drawing 4 laser diode 416) Incidence is carried out from one end face of the translucency medium 51, the lightwave signal by which incidence was carried out goes the inside of the translucency medium 51 straight on mostly, and reaches the reflected type light diffusion layer 53, and diffuse reflection is carried out to the vertical direction (the thickness direction of a translucency medium), and a longitudinal direction. The diffused light by which diffuse reflection was carried out repeats reflective propagation within the translucency medium 51, it is transmitted to the close outgoing radiation section, and outgoing radiation is carried out, and it is received with a photodiode 61 (each photodiodes 611, 612, 613, 614, 615, 616, 617, and 618). The received lightwave signal is changed into an electrical signal by light and the electric conversion circuit 60, and is transmitted to each electronic-circuitry substrate 20 (each electronic-circuitry substrates 201, 202, 203, 204, 205, 206, 207, and 208).

[0045] Angle-of-divergence 2theta to the longitudinal direction of the diffused light in which diffuse reflection was carried out by the reflected type light diffusion layer 53 here, By considering as the configuration which fills the relation of tantheta>=3tantheta', when the greatest prospective angle of the end face by the side of the close outgoing radiation to the end face by which the reflected type light diffusion layer 53 of said translucency medium 51 has been arranged is made into 2theta' Total reflection of the

diffused light is carried out on the side face of the translucency medium 51 once [at least] like the gestalt of the 1st operation. Furthermore, it becomes possible to make into homogeneity outgoing radiation light reinforcement transmitted to a photodiode 61 the outgoing radiation section side of the diffused light diffused according to the reflected type light diffusion layer 53. In addition, this diffused light is transmitted also to the incidence section.

[0046] Next, the modification of the gestalt of the 1st operation and the gestalt of the 2nd operation is explained. Drawing 5 - drawing 8 show the gestalt with which the reflector was established in the close outgoing radiation section of the lightwave signal transport unit 50 of the gestalt of the 1st operation, and the gestalt of the 2nd operation, respectively. The difference from the gestalt shown in drawing 2 thru/or drawing 4 is in the point that the field of the close outgoing radiation section is formed in 45 degrees to the underside of the translucency medium 51. Therefore, it becomes possible to the translucency medium 51 to perform close outgoing radiation of light perpendicularly (the thickness direction of the translucency medium 51).

[0047] With the gestalt (modification of the gestalt of the 1st operation) shown in drawing 5 (A) - drawing 5 (C), the penetrated type light diffusion layer 52 is arranged at incidence section 53A formed in 45 degrees to the underside of the translucency medium 51. It is diffused in the vertical direction and a longitudinal direction at the same time total reflection of the lightwave signal (lightwave signal which carried out incidence perpendicularly to the translucency medium 51) emitted from the laser diode 41 (for example, drawing 5 (A) laser diode 416) is carried out with the rear face of the penetrated type light diffusion layer 52. The diffused light repeats total reflection propagation, total reflection of it is again carried out in respect of the other end of the translucency medium 51, and outgoing radiation of the inside of the translucency medium 51 is carried out. The lightwave signal by which outgoing radiation was carried out is received with a photodiode 61 (each photodiodes 611, 612, 613, 614, 615, 616, 617, and 618).

[0048] In addition, as for the lightwave signal emitted from the laser diode 41, in drawing 5 (A) - drawing 5 (C), considering as collimation light is desirable. Thus, when breadth is in a laser beam from a laser diode 41, a part of light may be penetrated outside, without the ability filling total reflection conditions with the rear face of the penetrated type light diffusion layer 52. In such a case, you may make it establish the reflectors 55, such as aluminum, in the outside of the penetrated type light diffusion layer 52, as shown in drawing 6 .

[0049] Moreover, with the gestalt shown in drawing 5 and drawing 6 , total reflection conditions may not be filled with the end face by the side of the outgoing radiation of the translucency medium 51, but a part of light may be penetrated outside. In such a case, you may make it establish the reflectors 55, such as aluminum, in the outside (field formed in 45 degrees to the underside of the translucency medium 51) of the reflector by the side of the outgoing radiation of the penetrated type light diffusion layer 52, as shown in drawing 7 .

[0050] Next, with the gestalt (modification of the gestalt of the 2nd operation) shown in drawing 8 , the field of close outgoing radiation section 53B of the translucency medium 51 is formed in 45 degrees to the underside of the translucency medium 51. Total reflection of the lightwave signal (lightwave signal which carried out incidence perpendicularly (the thickness direction) to the translucency medium 51) emitted from the laser diode 41 (for example, drawing 8 laser diode 416) is carried out by incidence section 53B, it goes the inside of the translucency medium 51 straight on mostly, and reaches the reflected type light diffusion layer 53, and diffuse reflection is carried out to the vertical direction and a longitudinal direction. Outgoing radiation of the diffused light by which diffuse reflection was carried out is carried out to the lightwave signal and opposite direction which repeated total reflection propagation, and total reflection was again carried out in the outgoing radiation section, and carried out incidence of the inside of the translucency medium 51. The lightwave signal by which outgoing radiation was carried out is received with a photodiode 61 (each photodiodes 611, 612, 613, 614, 615, 616, 617, and 618). In addition, also in the gestalt shown in drawing 8 , as mentioned above, the gestalt which establishes reflectors, such as aluminum, suitably is also possible.

[0051] In addition, also in the gestalt of this operation, outgoing radiation light reinforcement is made to homogeneity like the gestalt of the 1st operation, and the gestalt of the 2nd operation.

[0052] In the example which gave [above-mentioned] explanation, although the eight close outgoing radiation sections (gestalt to which a laser diode 41 and eight photodiodes 61 are connected, respectively) were shown, the number of the close outgoing radiation sections can be formed not only in this but in an unit, 8 or less, and a pan by the number of arbitration, such as plurality.

[0053] Moreover, both an end-face luminescence mold laser diode (ELD) and a surface-emitting type laser

diode (VCSEL) are usable as a laser diode 41.
[0054] Furthermore, the gestalt which prepares a condensing operation of a ball lens etc., a collimator lens, etc. between a laser diode 41, a photodiode 61, and the lightwave signal transport unit 50 is sufficient.
[0055] Moreover, in the vertical side of the translucency medium 51, and a side face on either side, it is also possible to arrange a cladding layer with a refractive index smaller than the translucency medium 51 (not shown). Thereby, the translucency medium 51 surrounded by the cladding layer functions as the core section which forms a light guide line.
[0056] In addition, it is possible to use plastic material like polymethylmethacrylate, a polycarbonate, and amorphous polyolefine or inorganic glass for the translucency medium 51. Moreover, in the case of plastic material, it is producible also by approaches, such as injection molding. For example, the angle of divergence to the thickness direction of the translucency medium 51 of the diffused light and the angle of divergence to the cross direction of the translucency medium 51 are used as a desired angle to the translucency medium 51, using beam plastic surgery diffuser:LSD as the penetrated type light diffusion layer 52 and a reflected type light diffusion layer 53. The penetrated type light diffusion layer 52 (for example, the transparency mold LSD) imprints the hologram side which the epoxy layer arranged at transparence substrate ingredients, such as a polycarbonate, is made to diffuse in a predetermined diffusion angle to incident light, and is formed. Moreover, the reflected type light diffusion layer 53 (for example, the reflective mold LSD) imprints the hologram side which the epoxy layer of a reflective substrate (for example, transparence substrate with which film deposition of the aluminum was carried out) is made to diffuse in a predetermined diffusion angle to incident light, carries out film deposition of the aluminum etc. to the reverse side (rear face of a transparence substrate) of formation or the hologram forming face of the transparency mold LSD, and forms a reflector in it.
[0057] In addition, in the gestalt of the 2nd operation, while the laser beam by which incidence was carried out to the translucency medium 51 does not go the inside of the translucency medium 51 straight on but carries out total reflection of the inside of the translucency medium 51, when reaching the reflected type light diffusion layer 53, or when reaching the reflected type light diffusion layer 53, breadth being in incident light and carrying out total reflection of the inside of the translucency medium 51, the homogeneity of almost equivalent effectiveness and outgoing radiation light reinforcement is acquired.
[0058] [Gestalt of the 3rd operation] Next, the gestalt of operation of the 3rd of this invention is explained. In addition, as shown in drawing 10 and drawing 11 , it is respectively different [eight components] from the gestalt of the 1st operation mentioned above with the gestalt of this operation in that two or more laser diode arrays 410 (4101-4108) arranged by one dimension and photodiode arrays 610 (6101-6108) are used as the point of using two or more lightwave signal transport units 50 and luminescence, and a photo detector.
[0059] With the configuration of this example, transmission and reception of the juxtaposition lightwave signal which consists of two or more bits are attained. That is, the simultaneous transmission and reception of a lightwave signal which is different in each bit becomes possible.
[0060] The electrical signal which consists of two or more bits from each electronic-circuitry substrate 20 (for example, drawing 11 electronic-circuitry substrate 204) in the gestalt of the 3rd operation It is changed into a lightwave signal by the electrical and electric equipment and the optical conversion circuit 40. The 1-dimensional laser diode array 410 (-- for example, the lightwave signal emitted from laser diode component 4104) of the 1-dimensional laser diode array 410 in drawing 11 Incidence is carried out to the end face of the translucency medium 51 by which the penetrated type light diffusion layer 52 has been arranged, and it is spread in the vertical direction and a longitudinal direction at the same time it passes the penetrated type light diffusion layer 52. The diffused light repeats total reflection propagation within the translucency medium 51, and from the other-end side of the translucency medium 51, outgoing radiation of it is carried out and it is received by the 1-dimensional photodiode array 610 (each photodiode components 6101, 6102, 6103, 6104, 6105, 6106, 6107, and 6108). The received lightwave signal is changed into an electrical signal by light and the electric conversion circuit 60, and is transmitted to each electronic-circuitry substrate 20 (each electronic-circuitry substrates 201-208).
[0061] [Gestalt of the 4th operation] Next, the gestalt of operation of the 4th of this invention is explained. In addition, with the gestalt of this operation, as shown in drawing 12 and drawing 13 , luminescence and a photo detector are different from the gestalt of the 2nd operation mentioned above in that the laser diode array 4100 accumulated on two-dimensional and the photodiode array 6100 are used. In the gestalt of the 4th operation, further, the stair-like level difference 56 is formed in the end face of the translucency medium 51 of a rectangular parallelepiped configuration, and the lightwave signal transport unit 50 has the

composition that the reflected type light diffusion layer 53 has been arranged in the other-end side.
[0062] The electrical signal which consists of two or more bits from each electronic-circuitry substrate 20 (for example, drawing 13 electronic-circuitry substrate 205) in the gestalt of the 4th operation is changed into a lightwave signal by the electrical and electric equipment and the optical conversion circuit 40, in the incidence section in one end face of the translucency medium 51, total reflection of the lightwave signal emitted from the two-dimensional laser diode array 4100 (for example, drawing 13 laser diode component 41005 of the two-dimensional laser diode array 4100) is carried out, and incidence is carried out. The lightwave signal by which incidence was carried out goes the inside of the translucency medium 51 straight on mostly, and reaches the reflected type light diffusion layer 53, and diffuse reflection is carried out to the vertical direction and longitudinal direction of the translucency medium 51. The diffused light by which diffuse reflection was carried out repeats total reflection propagation within the translucency medium 51, and is transmitted to the close outgoing radiation section, total reflection of it is carried out again, and outgoing radiation is carried out. The lightwave signal by which outgoing radiation was carried out is received by the two-dimensional photodiode array 6100 (each photodiode components 61001, 61002, 61003, 61004, 61005, 61006, 61007, and 61008). The received lightwave signal is changed into an electrical signal by light and the electric conversion circuit 60, and is transmitted to each electronic-circuitry substrate 20 (each electronic-circuitry substrates 201, 202, 203, 204, 205, 206, 207, and 208).
[0063] In addition, with the gestalt of implementation of the above 4th, as shown in drawing 14 (A), the field of the stair-like edge of a level difference 56 is formed in 45 degrees for the configuration of the lightwave signal transport unit 50 to the underside of the translucency medium 51. It may be made to function as the close outgoing radiation section, and as shown in drawing 14 (B), it may be made to carry out incidence of the configuration of the lightwave signal transport unit 50 to two or more photodiodes by the diffused light diffused in the vertical direction in the reflected type light diffusion layer 53.
[0064]
[Effect of the Invention] Since he is trying for this invention to transmit lightwave signals other than the lightwave signal which carries out direct incidence to a predetermined field among the diffused lightwave signals to the predetermined field of a light guide means as explained above, it has the effectiveness that the utilization effectiveness of the light at the time of inputting into these two or more electronic-circuitry substrates the electrical signal outputted from either of two or more electronic-circuitry substrates can be raised.

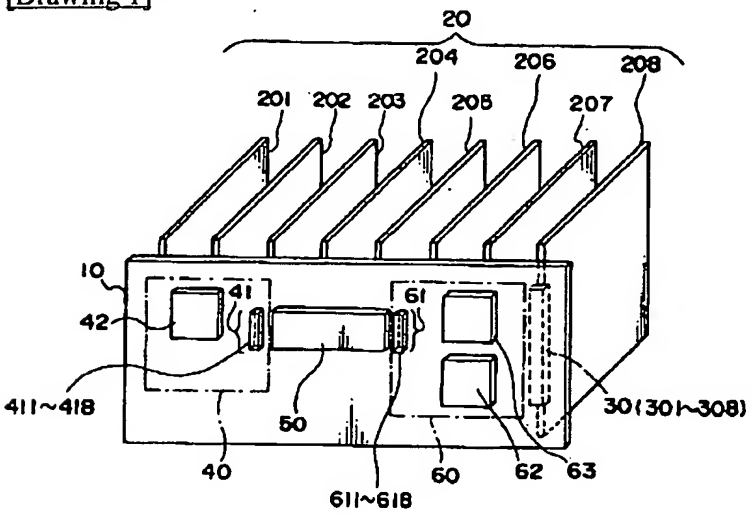
[Translation done.]

* NOTICES *

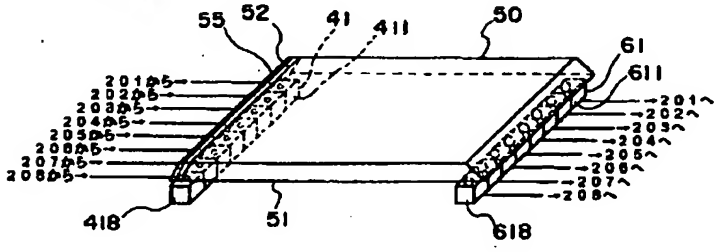
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

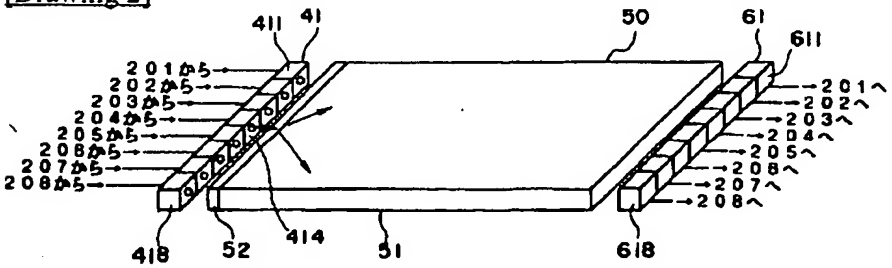
[Drawing 1]



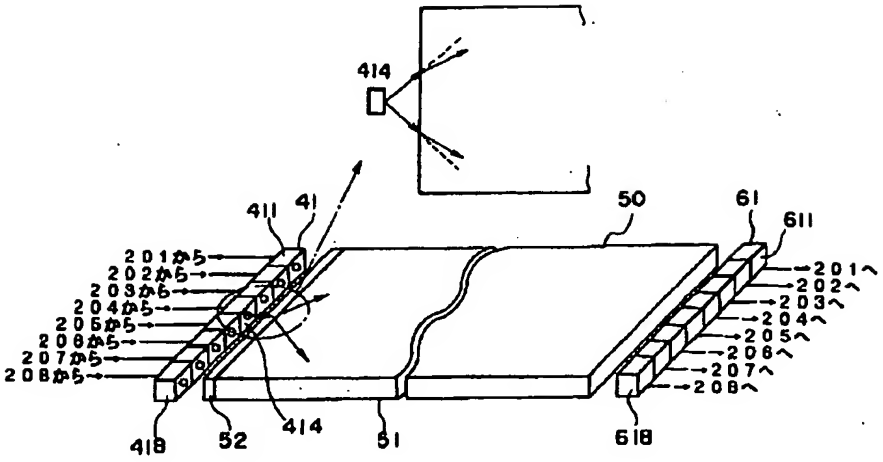
[Drawing 6]



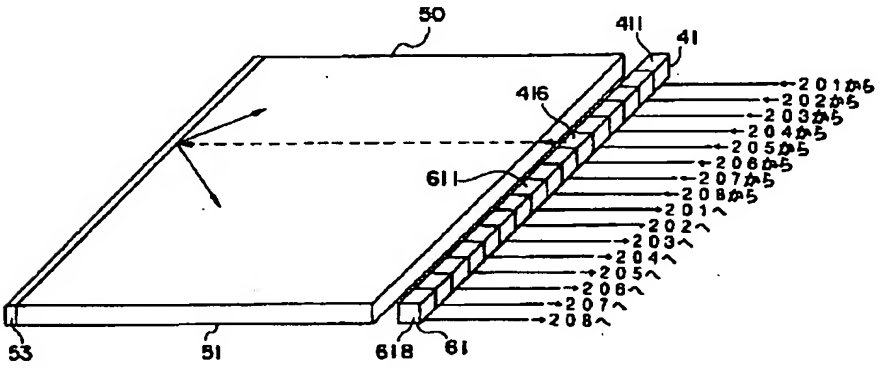
[Drawing 2]



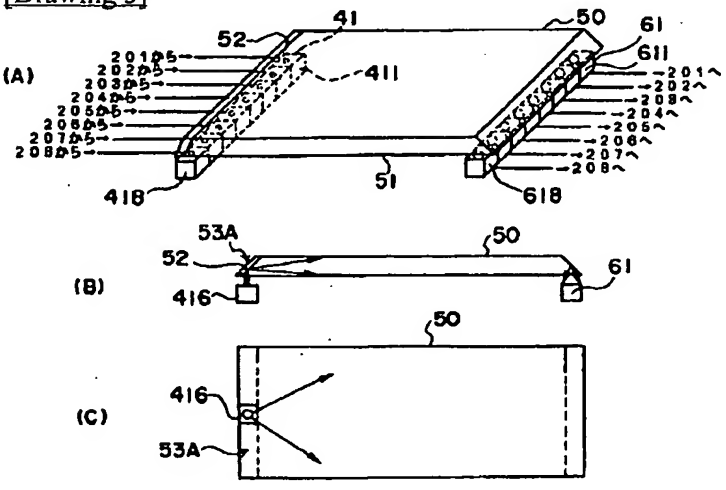
[Drawing 3]



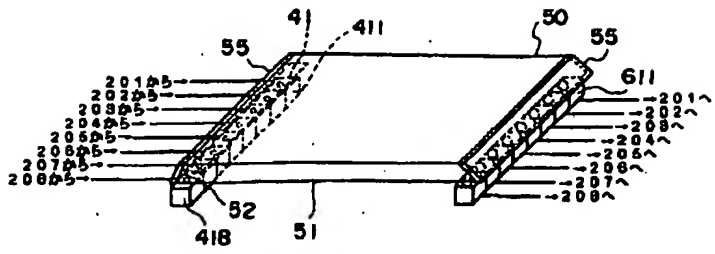
[Drawing 4]



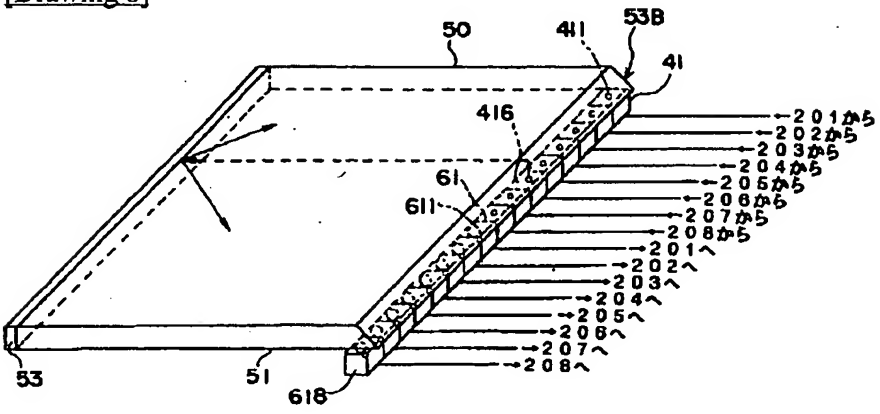
[Drawing 5]



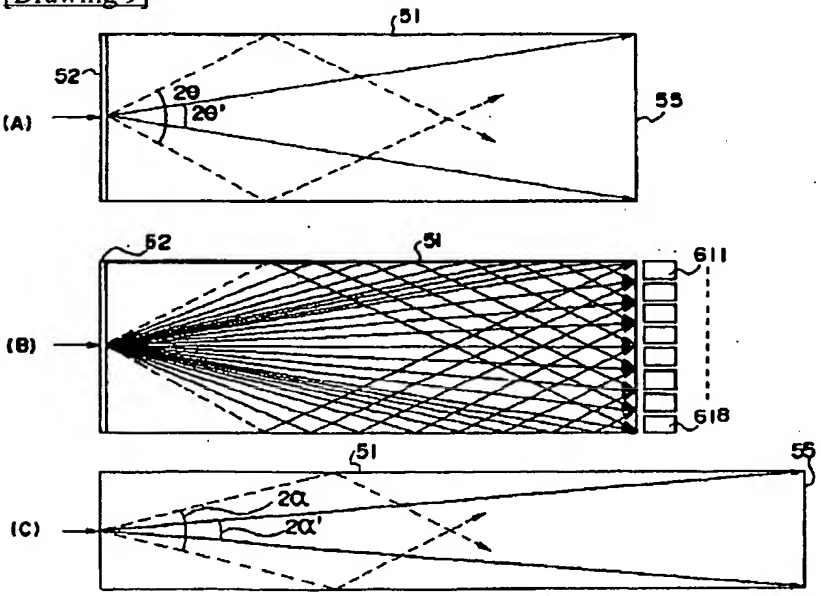
[Drawing 7]



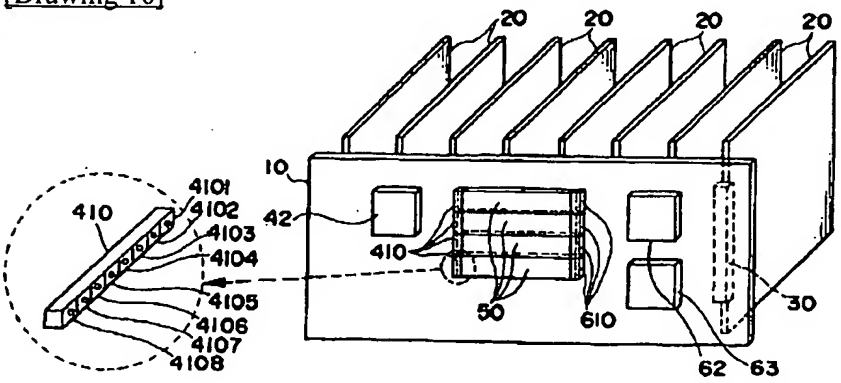
[Drawing 8]



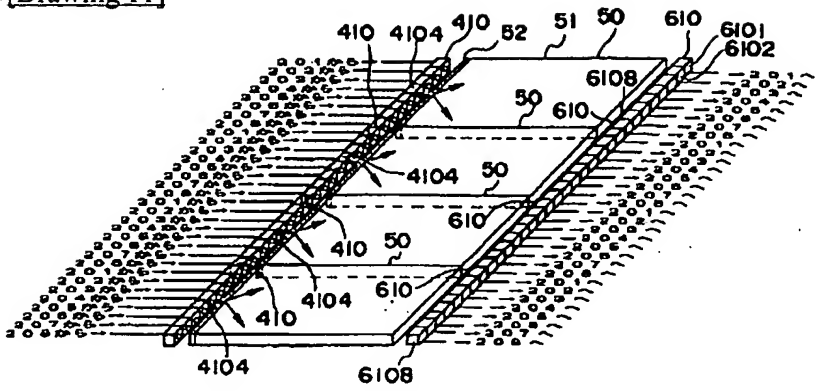
[Drawing 9]



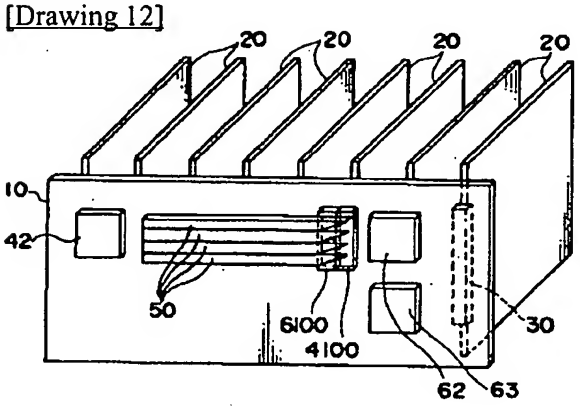
[Drawing 10]



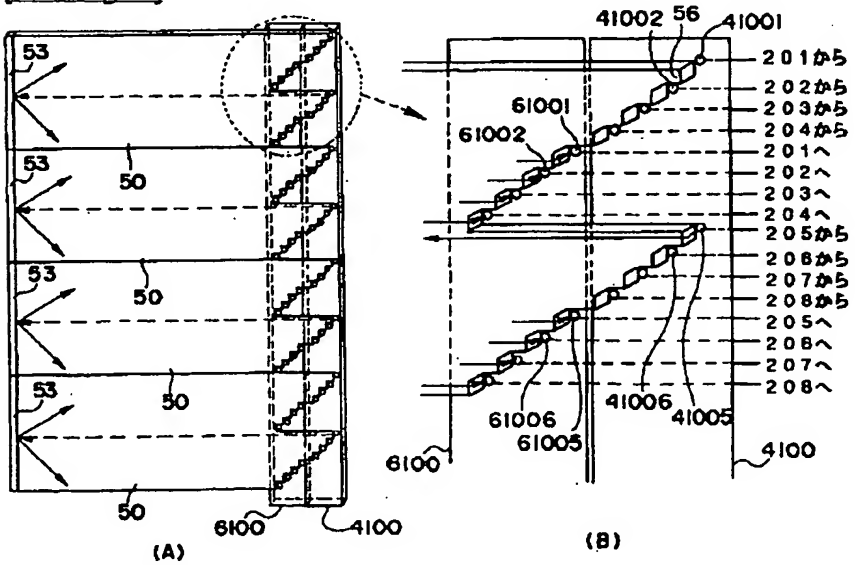
[Drawing 11]



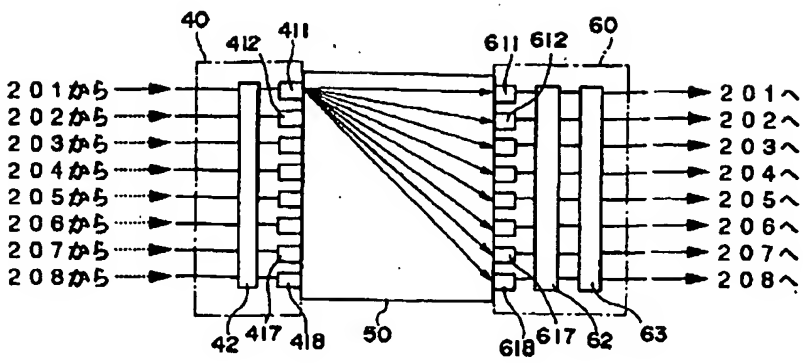
[Drawing 12]



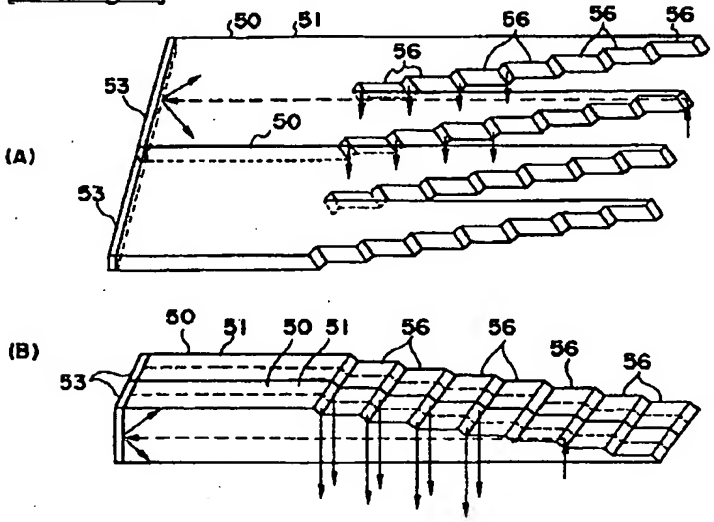
[Drawing 13]



[Drawing 15]



[Drawing 14]



[Translation done.]